SUPPLEMENTARY

A Chieftain PA-31-350 aircraft (Piper Aircraft, Inc., USA) and a King Air C90GT (Raytheon Co., USA) served as the measurement platform for this study. The Chieftain is a 10-seater and the King Air is an 8-seater and both use a twin propeller. Descriptions of two aircrafts are in Table S1. The Chieftain was used during 1997–2009 and November 2010, and King Air was used during May 2010 and 2011.

The two to three sampling nozzles in different size were designed to minimize the loss of sampling compounds and attached to the bottom of the aircraft not to be affected by the propeller and the exhaust gas. The gas measurement instruments were loaded on the aircraft. The geographical position of the aircraft was determined by the global positioning system (GPS) II pilot (Garmin) system and a sensor of the GPS was installed outside the aircraft to maintain accuracy of the measurements. The analyzed gas and geographical location data in real time were stored in the portable computer with the data processing program at 5-second intervals.

For Chieftain, three to four inverters were used to convert DC into steady AC current to stably supply power from the aircraft to the measurement instruments during flight, and for King Air, rated voltage was supplied as 220 V by the inverter and connected through two power supplies. Moreover, automatic mass flow controller (MFC, Tylon) was supplemented to the sampling system to keep the flow rate constant against the change of altitude.

Table S2 shows the general descriptions of relevant aircraft instrumentation. Sulfur dioxides (SO_2) were measured with Thermo-43C/43i (Trace level) by UV fluorescence and oxides of nitrogen (NO_x [NO and NO_2]) with Thermo-42C/43i (Trace Level) by ozone chemiluminescene/photolytic converter.

The calibration was conducted in a laboratory before and after the flight with the same condition as the installation in the aircraft. All calibrations were performed through the complete Teflon inlet line. After turning on the instrument and warming up for 2–3 hours to stabilize it before taking off, we set the values of the background concentrations by flow of zero gas. SO_2 and NO_x were corrected with the span gases passing through the dilution device. Detection limits for SO_2 and NO_x are 0.2 ppb for the case of 10-s average and 0.05 ppb for the case of 2-min average.

The aircraft took off from Gimpo International Airport, Taean airfield, and Muan International Airport. Flights were mostly conducted under westerly and over the oceanic region apart from the coastal region of Korea to analyze the long-range transported air pollutants and to exclude the effects from Korea. The flight routes and observation days were selected through the prediction of pathways of air pollutants using the Third Generation Community Multi-scale Air Quality Modeling System (Models-3/CMAQ). Typical flight routes consisted of vertical profiles up to 5 km and horizontal transections along the longitude over the Yellow Sea (32.64°N–37.67°N, 124.09°E–127.37°E).

Researchers who want these data can get them through an official communication with the Air Quality Monitoring and Forecasting Center in the National Institute of Environmental Research. The e-mail address of the person in charge (Chang-Keun Song, a coauthor of this paper) is cksong@me.go.kr.

Table S1. Descriptions of aircrafts used in this study.

	King Air	Chieftain
Manufacturer	USA, Raytheon	USA, PIPER
Owner	Hanseo univ.	ChangUn Airline
Model	King Air C-90GT	Chieftain
Engine Capacity	550 HP	350 HP
Length	10.82 m	10.55 m
Height	4.34 m	3.96 m
Width	15.32 m	12.40 m
Landing Weight	4,354 kg	3,175 kg
Takeoff Weight	4,581 kg	3,175 kg
Fuel Load Capacity	384 gal (1,488 L)	192 gal (727 L)
Max Cruising Speed	486 km/h	402 km/h
Avg Cruising Speed	461 km/h	373 km/h
Long Dis Cruising Speed	400 km/h	315 km/h
Cruising Distance	1,918 km	1,971 km
Cruising Time	6.25 hr	6.9 hr
Cruising Climb	9,144 m	8,626 m
Zero Fuel Weight	3,152 kg	1,810 kg
Loading Capacity	157 kg	1,365 kg

Table S2. Descriptions of relevant instruments equipped in the aircraft.

Parameter	Operation principal	Instrument model	Range and unit	Response time	Precision
SO_2	UV Fluorescence	Thermo-43C/43i Trace	≤ 100 ppb	80 s (10 s avg.)	0.2 ppb (10 s avg.)
NO_x	Chemiluminescence/Photolytic converter	Thermo-42C/43i Trace	≤ 100 ppb	60 s (10 s avg.)	0.05 ppb (2 min. avg.)